EMPLOYMENT, PRODUCTION AND INCOME BY SECTOR IN SPAIN: ECONOMETRIC MODELS AND COMPARISON WITH GERMANY AND THE UNITED STATES, 1965-2010

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Abstract.
We analyse the evolution of real valued-added by sector accordingly to two approaches: production and income in Spain in comparison with Germany, the USA and other OECD countries. We found that the quick increase of employment in Building and Services in Spain for the period 1995-2007 was unsustainable due to the lack of an even evolution of Industrial production. Economic policies for the period 1995-2012 did not foster the necessary increase in real production per inhabitant, in order to reach high rates of employment and convergence of productivity, real wages and real income per capita to more advanced economics. Here we present the estimation of econometrics models which have into account the impact of industrial development on real value-added and employment by sector.
Keywords: Employment by sector, Production and Income by Sector, Spain, Agriculture, Industry, Building, Services.
JEL codes: J0, J11, J4, O51, O52

1. Real Income per capita, by sector in Spain, Germany and the USA, 1970-2010

We analyze the evolution of real value-added by sector and their impact on employment. Graphs 1 to 4 show the evolution of real income per capita generated in Agriculte, Industry, Building and Services of three countries: Spain, Germany and the USA, for the period 1970-2012.

Real Income per capita in Agriculture shows a negative trend, not due to the diminution of production but to the diminution of the Index of Relative Prices of this sector, as it may be seen in the Annex and in the sources there cited.

Spain has a level of real income per capita in Agriculture very alike to the value of the USA, and higher than Germany. The value of Spain is lower in Industry and Services.

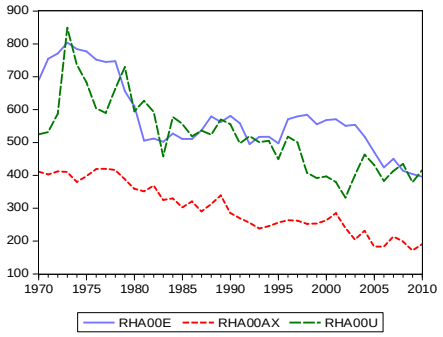
Both USA and Germany are highly industrialized countries for the period 1970-2010, while Spain started with a low value in 1970 and has experienced little increase in real income of industry per capita for the period 1970-2007. These three countries, like many industrialized countries, have experienced a decrease in industrialization in year 2008 with a recovery in the cases of Germany and the USA in 2009-2010.

In building sector, Spain evolved from below 600 in year 1970 to 1000 around year 2000, 1800 in year 2007 and diminished to 1400 in year 2010. Germany evolved from an estimation of nearly 1400 in year 1970 to 1000 around year 2000, 800 in year 2005 and slight increase in the prior 2005-2010. The USA evolved from 1000 in year 1970 to 1600 in year 2000, 1800 in year 2007 and a diminution to around 1300 in year 2010.

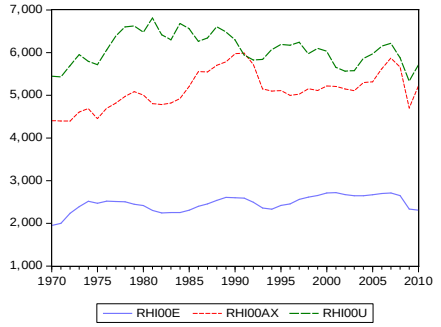
We notice that countries with high levels of real value-added in industry usually reach high levels of real value-added in services, as expected accordingly to the Kaldor´s view of intersectoral relationships analysed in Guisan(2007) and other studies.

In Guisan(2012) we present more detailed data for real valued-added of Agriculture, Industry, Building and Services in Spain, Germany and the USA, accordingly to the *production approach* (nominal value-added deflated by the index of price of the production sector) and to *the income approach* (nominal value-added deflated by the index of price of consumption). While the first approach is an indicator of the quantities produced the second approach is an indicator of the capacity of real consumption of the income generated in the sector

Graph 1. Real income per capita in Agriculture

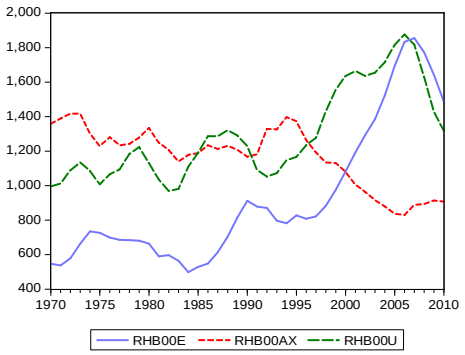


Graph 2. Real income per capita in Industry

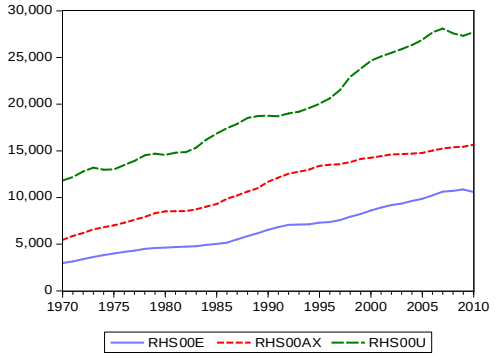


Notes: Valued-added per inhabitant (income approach) in Dollars of year 2000. In the electronic version the color lines are as follows: blue for Spain, red for Germany and Green for the USA.
Source: Elaborated by Guisan and Exposito(2013) from OECD data.

Graph 3. Real income per capita in Building



Graph 4. Real income per capita in Services



Note: Valued-added per inhabitant (income approach) in Dollars of year 2000. In the electronic version the colour lines are as follows: blue for Spain, red for Germany and Green for the USA.
Source: Elaborated by Guisan and Exposito(2013) from OECD data.

The main failures of Spain, to get a sustainable increase in the rate of employment, have been the lack of enough development of industry and excessive foreign trade deficit. Table 1 presents a summary of the evolution of real income per inhabitant in the three countries of this study, together another three OECD countries: France, Italy and Poland.

Table 1. Real Value Added *(production approach)* in EU6 y USA,
($ per capita at 2000 prices and Purchasing Power Parities (PPP)

Country Δ (%)	Año	Agri	Ind	Build	S1	S2	S3	Serv	Total
Germany	1995	258	5236	1392	3664	5442	4826	13932	20818
3143	2000	291	5773	1194	4184	6339	5247	15770	23028
(15.09%)	2005	295	6142	953	4439	6776	5356	16571	23961
Spain	1995	605	3294	1310	4470	2950	3514	10934	16142
4100	2000	831	3967	1583	4962	3695	3947	12604	18986
(25.40%)	2005	685	3867	1953	5187	4254	4295	13736	20242
France	1995	621	3700	1373	3838	6490	5603	15932	21626
3452	2000	679	4245	1234	4513	7340	5914	17768	23925
(15.96%)	2005	646	4403	1273	4774	7874	6108	18756	25078
UK	1995	229	4867	1167	4203	4857	4812	13872	20135
4981	2000	237	5157	1239	5367	6482	5075	16924	23556
(29.06%)	2005	233	4787	1413	6162	7867	5525	19553	25986
Italy	1995	580	5227	1100	4827	5002	4269	14098	21005
2628	2000	638	5340	1140	5457	5640	4584	15680	22799
(12.51%)	2005	622	5025	1318	5783	6002	4883	16668	23633
Poland	1995	464	1687	569	1898	1262	1507	4667	7388
3618	2000	467	2257	728	2568	1704	1694	5967	9419
(48.97%)	2005	546	2796	658	3088	2004	1914	7006	11006
USA	1995	274	5602	1348	4950	8214	7376	20539	27762
6667	2000	397	6289	1527	6364	10205	7498	24067	32280
(24.01%)	2005	368	6396	1473	7049	11189	7954	26192	34429

Notes: In the first column: Δ = increase in 1995-2005.Sectors: Agriculture (Agri), Industry (Ind), Building (Build). Commercial Services (S1), Financial and Businnes Services (S2), Social and Community Services (S3). Source: Elaboration by Guisan(2009) from OECD statistics.

We notice that countries with high levels of real value-added in industry usually reach high levels of real value-added in services, as expected accordingly to the Kaldor´s view of intersectoral relationships analysed in Guisan(2007) and other studies.

2. Evolution of employment by sector in Spain, 1965-2012

Table 2 presents a comparison of the employment rates by sector of Spain and other OECD countries in the period 1995-2010. We notice a positive evolution of employment, for the period 1995-2010, in several countries, in spite of the economic crisis of years 2008-2010. The highest rates of employment in year 2010 correspond to the United Kingdom, Germany and the USA, and the lowest value corresponds to Spain in spite of the high increase of employment in this country for the period 1995-2010.

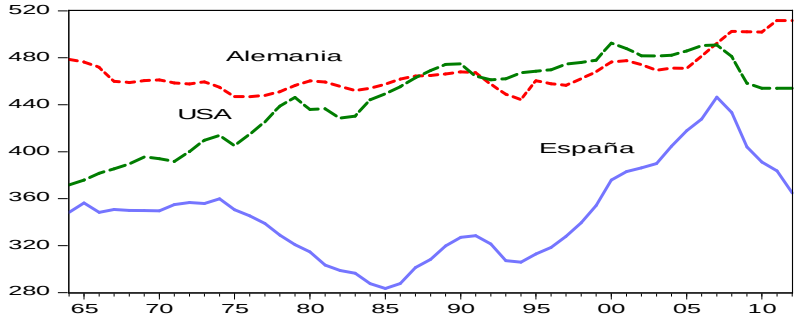
In Agriculture the highest rates of employment correspond to Spain and Italy. In Industry the highest are Germany and Italy. In Building sector, Spain and the United Kingdom show the highest values in year 2010, although there are not major differences among the countries of the table. Finally the highest rates in Services correspond to the UK, Germany and the USA.

Table 2. Rates of Employment (employed persons per one thousand people), 1995-2010

Country	Agriculture		Industry		Building		Services		Total	
	1995	2010	1995	2010	1995	2010	1995	2010	1995	2010
Germany	14	8	118	95	41	28	265	371	438	494
Spain	28	18	63	56	29	35	193	285	313	376
France	18	10	68	50	25	30	281	324	392	414
Italy	23	16	93	78	28	31	242	290	486	415
UK	9	6	81	42	32	34	360	426	482	508
USA	13	7	84	53	29	29	343	364	369	453

Graph 5 presents the evolution of the rates of employment by sector in Spain, in comparison with Germany and the USA, for the period 1964-2012. We notice that Spain experienced a high increase in the rate of total employment for the period 1996-2007, with 8.2 million new employments, but unfortunately this upward movement was followed a downward movement for the period 2008-2012 with the lost of 3.9 million employments since 2007 quarter 3rd to 2013 quarter 1st.

Graph 5. Rates of total employment in Spain, Germany and the USA, 1964-2012
(employed persons per one thousand people)



Note: Blue colour line corresponds to Spain, red line to Germany and green line to USA. Source: Elaborated by Guisan and Exposito(2013) from OECD statistics.

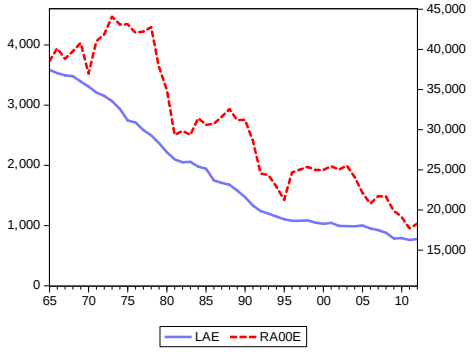
Employment and Value-Added by sector in Spain: problem with austerity measures

Graph 6 presents the evolution of Employment and Real Income of Agriculture in Spain for the period 1964-2012. Graphs 7 to 9 show the evolution of the first differences of employment and real value-added of Industry, Building and Services (production approach). Graph 10 shows a quick increase of Active Population and Employment in Spain for the period with wage stagnation in wages and decline in productivity.

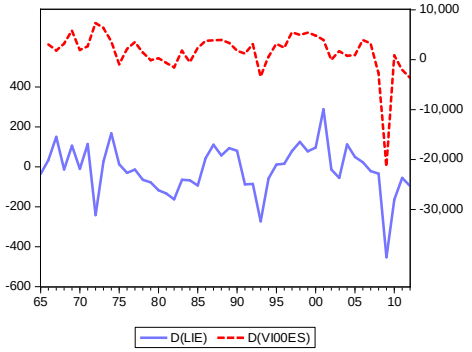
We may notice a high positive correlation of the evolution of employment and real production in the sectors of Industry, Building and Services. In the case of Agriculture there is usually a positive correlation between employment and production, although the correlation between employment and real income is higher.

The decline in real value-added of Industry has an important role to explain the decline in other sectors. Austerity measures imposed in Spain for years 2008-2013, after a period of high foreign deficit for years 2003-2007, present many problems for employment.

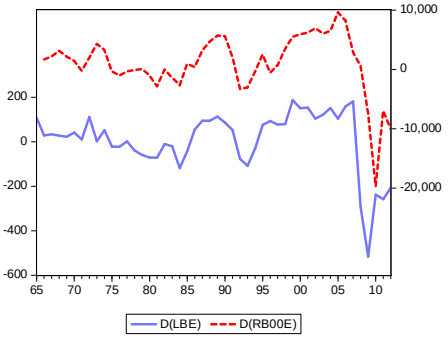
Graph 6. Employment and Real Income Agriculture in Spain, 1964-2012



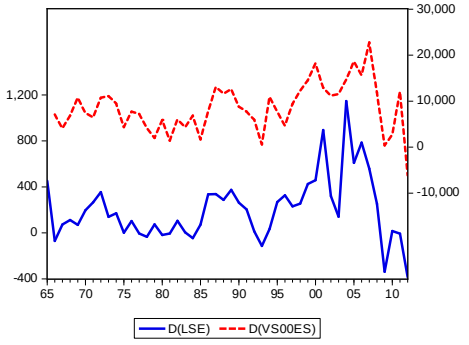
Graph 7. Increases of LI and real VI: Industry, Spain, 1965-2012



Graph 8. Increases of LB and VB: Building

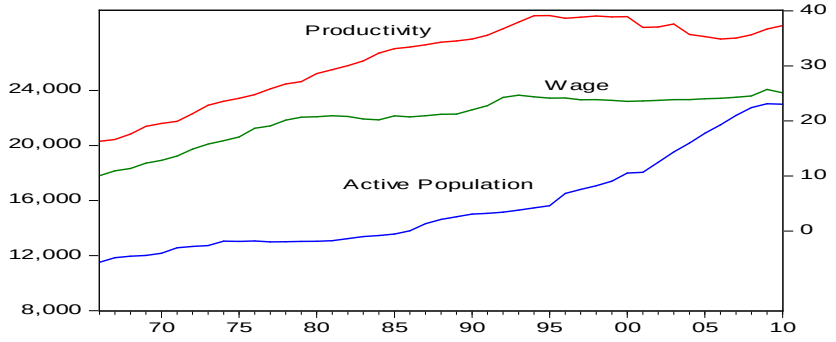


Graph 9. Increases of LS and VS: Services



Notes: LjE= Employment of sector j in Spain, for j= A (Agriculture), I (Industry), B (Building), S (Services). RA00E = Real income of Sector A in Spain (Value-Added at current prices)/IPC00ES). Vi00ES= Real value-added of Sector i in Spain, production approach (Value-Added at current prices)/IPj00ES). IPC is the index of prices of private consumption and IPj the index of price of Value-Added of sector j. Source: Elaborated by Guisan and Exposito(2013) from OECD statistics.

Graph 10. Evolution of Active Population, Productivity and Wages in Spain, 1965-2010



Source: Elaborated by Guisan and Exposito(2013) from INE statistics

3. Econometric models: Employment and real Value-Added in Spain, 1966-2012

In table 3 we present our estimations of equations that relate employment in the production sectors of Agriculture, Industry, Building and Services with real Value-added in Euros at 2000 prices, accordingly to the production approach. The sample corresponds to Spain for the period 1966-2010, and the data source is INE(2013). The full results of the estimation are included in the Annex. The equations are mixed dynamic models:

$$y_t = \beta_1 y_{t-1} + \beta_2 D(x_t) + \varepsilon_t$$

where y_t is employment (LiES) and x_t is real Value-Added (Vi00ES), for i=A,I,B,S. Employment is measured in thousand persons and real Value-Added in million Euros at constant prices of year 2000.

Table 3. Employment and Value-Added by sector in Spain, production approach, 1966-2012

Sector	Y	Y(-1)	D(X1)	R^2	% S.E.
Agriculture	LAES	0.9684 (288)*	8.753 (1.46)	0.9973	2.60
Industry	LIES	0.9851 (200)*	19.488 (5.90)*	0.9096	3.19
Building	LBES	0.9908 (96)*	22.039 (6.30)*	0.9581	7.44
Services	LSES	0.9884 (152)*	35.243 (6.88)*	0.9962	2.63

Notes: Y=sectoral employment (thousand people) in year t, Y(-1)=lagged value of sectoral employment (Y_{t-1}). D(X1)= increase of the explanatory variable X1. X1=real Value-Added, production approach. The t-statistics, between parentheses, are indicated with * for parameters significant at 5% level. % S.E. is the percentage of S.E on the mean of dependent variable.

Table 4. Employment and Value-Added by sector in Spain, income approach, 1966-2012

Sector	y	y(-1)	d(X2)	R^2	% S.E.
Agriculture	LAES	0.9705 (302)*	8.475 2.43)*	0.9975	2.50
Industry	LIES	0.9872 (191)*	17.491 (4.81)	0.8934	3.43
Building	LBES	0.9830 (111)*	21.425 (8.57)*	0.9700	6.29
Services	LSES	1.0122 (188)*	13.597 (4.28)*	0.9945	3.18

Notes: Y=sectoral employment (thousand people) in year t, Y(-1)=lagged value of sectoral employment (Y_{t-1}). D(X2)= increase of the explanatory variable X2. X2= real Value-Added, income approach. The t-statistics, between parentheses, are indicated with * for parameters significant at 5% level. % S.E. is the percentage of S.E on the mean of dependent variable.

In Agriculture and Building the results as slightly better in table 4 (income approach) than in table 3 (production approach), while in the cases of Industry and Services the goodness of fit is slightly better in the equations of table 3 (production approach) than in table 4 (income approach). In the Annex we include more detailed results.

There are other variables that have also impact on employment, but here we have included only the two variables which usually are the most important: the lagged value of employment and the increase in real value-added. In other studies we analyze the effects of other variables. Guisan(2012) presents an interesting estimation of a non lineal model which explains employment and real wages in 6 OECD countries. In that model employment depends on its lagged value, the increase of the ratio Q/W (where Q is real Gross Domestic Product and W (Wage) is real average labour cost) and the increase of Active Population. Wage equation was estimated as a function of its lagged value and the increase of Productivity.

4. Econometric models: Real Value by sector in Spain, 1966-2012

We present our estimations of equations of real Value-Added by sector in Spain for the period 1965-2012. Data have been elaborated from INE (2012).

Both demand and supply factors have influence in the evolution. Although supply has been the main source of explanation in industry the excessive austerity measures of Spain for 2008-2012 have shown a negative impact on industry from the demand side.

Variables of the models are Value-added, expressed in Euros at 2000 prices, and Indexes of Prices base=1 in year 2000. Some equations include also a time trend (Ti=0 in year 1970, Ti=1,2,… for years 1971 and upwards and -1, -2, … for year 1969 and downwards). Equation 5 also includes Exports and Imports of goods.

Vj00ES: real Value-Added of sector j, production approach.
VNj00Es: real Value-added of other sectors (no sector j), production approach

Rj00ES: real Value-Added of sector j, income approach

RNj00ES: real Value-Add of other sectors (no sector j), income approach

IPRj00ES: index of relative price of sector j: IPRAES=IPA00ES/IPC00ES

IPj00ES= index of price of sector j. Deflactor of sector i: (Vi current prices)/(Vi00ES)

IPC00ES= Index of Prices of Private Consumption in Spain, base 1 in year 2000.

for i= A (Agriculture), I (Industry), B (Building), S (Services).

EXPG00ES and IMPG00ES, which account for real values of exports of goods and imports of goods in Spain, are include in equation 5.

4.1. Equations of real Value-Added and Price of Agriculture.

The model specifies demand and supply equations for production in Spain (*va00es*), in the line of the model estimated by Guisan and Exposito(2004) with a pool of 4 OECD countries.

The variables real value-added of agriculture (va00es) and index of relative price of agriculture (ipra00es) are endogenous. The model is recursive because equation (1) does not depend on $ipra00es_t$ but on its lagged value. The estimation has been performed by NLS (non linear least squares), with natural logarithms of the variables:

Supply: $\log(va00es_t) = \log(va00es_{t-1}) + c(1)*d(\log(ipra00es_{t-1}))$

Demand : $\log(va00es_t) = \log(va00es_{t-1}) + c(2)*d(\log(vna00es_t)) + c(3)*d(\log(ipra00es_t)$

After estimation we use supply equation to forecast va00es and demand equation to forecast ipra00es.

Guisan and Exposito (2004) present an interesting estimation of the relationships between production and prices in Agriculture with a pool of several OECD countries.

Equation for price, deduced from the estimated demand equation:

$$\text{Log}\,(\widehat{ipra00es_t}) = a_1\ d(\log(va00es_t) + a_2\ d(\log(vna00es_t) + (\log(ipra00es_{t-1})$$

Where $a_1 = 1/(c(3) = -2.34$; $a_2 = -c(2)/c(3) = 0.4493$

Thus an increase in Agriculture demand, given by an increase in vna00es shows a positive effect on relative price while an increase in supply not accompanied by increase in demand implies a negative price on relative price.

Graphs 11 and 12 show actual and estimated values of va00es and ipra00es.

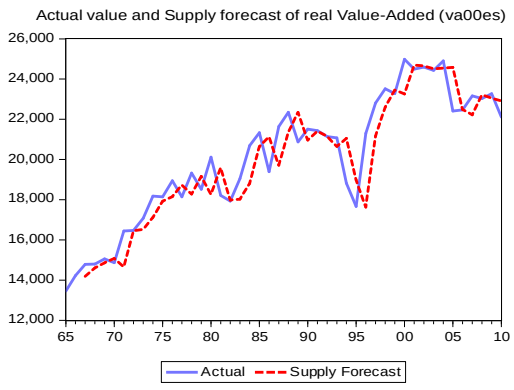
Equation 1. Supply equation: Real Value-Added of Agriculture in Spain

Dependent Variable: LOG(VA00ES). Method: Least Squares. Sample: 1967 2010				
LOG(VA00ES)=LOG(VA00ES(-1))+C(1)*D(LOG(IPRA00ES(-1)))				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.166443	0.151745	1.096857	0.2788
R-squared	0.837720	Mean dependent var		9.9094
Adjusted R-squared	0.837720	S.D. dependent var		0.1499
S.E. of regression	0.060388	Akaike info criterion		-2.7535
Sum squared resid	0.156808	Schwarz criterion		-2.7130
Log likelihood	61.57906	Hannan-Quinn criter.		-2.7385
Durbin-Watson stat	2.109011	Mean Absolute Percentage Error		4.36

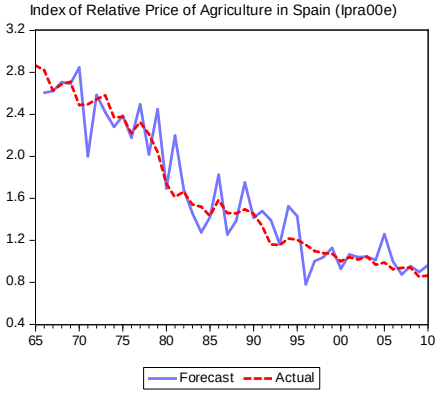
Equation 2. Demand equation: Real Value-Added of Agriculture in Spain

Dependent Variable: LOG(VA00ES). Method: Least Squares, Sample (adjusted): 1966 2010				
LOG(VA00ES)=LOG(VA00ES(-1))+C(2)*D(LOG(VNA00ES))+C(3) *D(LOG(IPRA00ES))				
	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	0.191813	0.202308	0.948123	0.3484
C(3)	-0.426889	0.140119	-3.046607	0.0039
R-squared	0.880752	Mean dependent var		9.9017
Adjusted R-squared	0.877979	S.D. dependent var		0.1569
S.E. of regression	0.054824	Akaike info criterion		-2.9259
Sum squared resid	0.129246	Schwarz criterion		-2.8456
Log likelihood	67.83359	Hannan-Quinn criter.		-2.8960
Durbin-Watson stat	2.062941	Mean Absolute Percentage Error		3.85

Graph 11. Va00es: actual and fitted



Graph 12. Ipra00es: actual and fitted



4.2. Equation of Real Value of Industry. Development of Industry depends not only of the variables here included but also on other important variables related with investment, rules that favour industrial development, innovation, human capital and other ones.

In Guisan, Cancelo and Frias(2001), and in other studies, we have developed several models related with the explanation of industrial development. In that study we presented the estimation of a production function of a pool of 11 OECD countries for the period 1975-1990, as supply equation, and a demand equation related with domestic and foreign demand and with international relative price. In that study we applied specification tests and forecasting capacity, to select between demand or supply as the main approach for the explanation of manufacturing. For that period supply showed to be the leading force, with investment as the main factor explaining the evolution of industry, while demand showed a positive but lower effect. In some degree it seemed that the Say´s hypothesis that "supplies create its own demand" was true.

But in the period 2007-2012 there was low degree of capacity utilization in the industrial sector of Spain, and thus it is not the supply side what is failing and explaining the diminution of the industrial production index (IPI) about 25% for the period 2005-2012. A more detailed explanation of the circumstances of this crisis in Spain and other European countries is presented in Guisan and Vazquez (2013). Here we only present the estimation of demand equations 3.1 and 3.2 with data of Spain for the period 1966-2012.

Equation 3.1 is a log linear model that relates real value added of industry with its lagged value, the increase of index or relative prices, the increase of real value-added of non industrial sectors and time (Ti). Variables are expressed in natural logarithms.

Equation 3.2 is a linear model that relates real value-added of industry with two components of demand: real private consumption, real exports of goods and services. Besides it includes a time trend (Ti) to account for some effects of omitted variables.

Table 5. Demand equations 3.1 and 3.2 for real value-added of Industry in Spain, 1966-2012

Equation 3.1. Dependent variable log(vi00es)		Equation 3.2. Dependent variable vi00es	
Explanatory variables	Coefficient (t-stat)	Explanatory variables	Coefficient (t-stat)
Log(vi00es(-1)	0.9989 (1013)*	vi00es(-1)	0.9921 (130)*
Log(d(vni00es))	1.2927 (6.73)*	d(c00es)	0.4083 (11.78)*
Log(d(ipri00es))	-0.6977 (-3.99)*	d(expt00es)	0.1907 (5.48)*
Ti	-0.000446 (-1.27)	Ti	-98.33 (-3.30)*
S.E. of vi00es	4850	S.E. of vi00es	1636
Sum Squares of Resid.	1.04 E+09	Sum Squares of Resid.	1.15 E+08
% S.E.	10.62	% S.E.	1.87
MAPE	4.62	MAPE	7.23

Both equations show a high goodness of fit. While equation 3.2 shows lower Sum of Squares and lower % S.E. on the mean of vi00es than equation 3.1, the comparison in terms of MAPE (Mean of Absolute Percentage Error) of dynamic forecasts for the sample period was lower in equation 2.

4.3. Equation of real Value of Building. The equation relates value added with real income in other sectors and relative price. Indeed there are other variables which are significant, particularly the financial facilities which where high in the period 2001-2007

and decrease deeply for 2008-2012. We expect to include the effects of those explanatory variables in future studies. The equation includes factors of demand and supply.

This sector shows a positive effect of the increase in relative price on real activity, what contributes to explain, in part, the *investment bubble* that happened in the dwellings sector of Spain in the first decade of the 21st century. Increasing prices may lead to higher expectations and make more attractive investment in this sector, as until the bubble stops.

Equation 4. Real Value-Added of Building related with IPRB and RNB

Dependent Variable: LOG(VB00ES). LS. 1966-2010				
Variable	Coeff.	Std. Error	t-Stat.	Prob.
LOG(VB00ES(-1))	0.999055	0.000900	1110.0	0.0000
D(LOG(IPRB00E))	0.279023	0.157295	1.77	0.0833
D(LOG(RNB00ES))	1.116873	0.221477	5.04	0.0000
R-squared	0.986794	Mean dep. var		10.4587
Adjusted R-squared	0.986165	S.D. dep. var		0.3675
S.E. of regression	0.043228	Akaike info crit.		-3.380
Sum squared resid	0.078484	Schwarz criterion		-3.259
Log likelihood	79.05713	Hannan-Quinn crit.		-3.335
Durbin-Watson stat	1.224679			

The increase of real income and other sector (RNB00ES) shows a positive and significant effect on real Value-Added of the building sector.

4.4. Equation of real value-added of Services. The equation relates value added of Services with value-added of Industry, Imports and relative Price. It has into account supply factors (intermediate goods produced by domestic industry or imported).

Equation 5. Real value-added of Services related with Industry and Imports

Dependent Variable: LOG(VS00ES). LS 1993-2012				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
VS00ES(-1)	1.028373	0.003565	288.4604	0.0000
D(VI00ES)	1.424117	0.386003	3.689390	0.0020
D(IMPG00ES*1000)	0.121997	0.151617	0.804638	0.4328
D(EXPG00E*1000)	-0.590313	0.224377	-2.630896	0.0182
R-squared	0.995811	Mean dependent var		411469.9
Adjusted R-squared	0.995026	S.D. dependent var		74379.03
S.E. of regression	5245.958	Akaike info criterion		20.14516
Sum squared resid	4.40E+08	Schwarz criterion		20.34431
Log likelihood	-197.4516	Hannan-Quinn criter.		20.18404
Durbin-Watson stat	2.397974			

Industry shows a positive and strong impact on real value-added of Services. Industry has positive effects both directly and indirectly (because industry contributes to increase real exports and to increase the capacity of the country to increase imports without increasing trade balance deficit).

A failure of Spanish policies in the period 2003-2008 has been a big increase of foreign debt, generated by trade deficits (Imports higher than Exports), what has created a high

degree of dependence on foreign credit, with negative consequences on the Spanish development for years 2008-2013, during the international financial crisis. The austerity measures imposed during that have been addressed to the diminution of trade deficit of goods but, unfortunately, they have not led to increase real value-added of industry which is very important to favour both domestic development and a balanced foreign trade account, because industrial goods are used as intermediate goods in domestic production of other sectors and they also contribute to increase exports of goods.

5. Conclusions

The Spanish economy has experienced a high increase of employment, with more than 8 million new employments, during the period 1995-2007, but unfortunately near 4 million employments were lost for the period 2008-2012, generating a high increase of unemployment during those years.

The analysis by sector and the econometric models show that employment diminution in Agriculture has been explained by the diminution of real income as a consequence of the persistent decrease of relative prices.

Regarding non agrarian employment the main reason of decrease has been the stagnation and diminution of real value-added of industry, with negative consequences on other non agrarian sectors, particularly on real value-added and employment in services. In order to make the increase of employment sustainable it is important to have into account the effects of industry on other sectors.

While industrial development in Spain has been addressed mainly from the supply side for the period 1965-2007, we find a low level of capacity utilization for the period 2008-2012, due to the imposition of severe and excessive austerity measures. Spain should learn from this crisis to trust more in balanced development and to avoid excessive deficits and increase in international debt.

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Annex 1. Econometric models of employment and real value-added

Agriculture: production approach

Dependent Variable: LAE
Method: Least Squares
Sample (adjusted): 1966 2012
Included observations: 47 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LAE(-1)	0.968416	0.003358	288.3921	0.0000
D(VA00ES)	0.008753	0.005968	1.466670	0.1494

R-squared	0.997382	Mean dependent var	1814.222
Adjusted R-squared	0.997324	S.D. dependent var	910.9831
S.E. of regression	47.12397	Akaike info criterion	10.58506
Sum squared resid	99930.08	Schwarz criterion	10.66379
Log likelihood	-246.7490	Hannan-Quinn criter.	10.61469
Durbin-Watson stat	1.466367		

Agriculture: income approach

Dependent Variable: LAE
Method: Least Squares
Sample: 1966 2012
Included observations: 47

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LAE(-1)	0.970594	0.003204	302.9237	0.0000
D(RA00E)	0.008475	0.003484	2.432381	0.0190

R-squared	0.997576	Mean dependent var	1814.222
Adjusted R-squared	0.997522	S.D. dependent var	910.9831
S.E. of regression	45.34806	Akaike info criterion	10.50823
Sum squared resid	92540.09	Schwarz criterion	10.58696
Log likelihood	-244.9435	Hannan-Quinn criter.	10.53786
Durbin-Watson stat	1.829039		

Industry: production approach

Dependent Variable: LIE
Method: Least Squares
Sample (adjusted): 1966 2012
Included observations: 47 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LIE(-1)	0.985199	0.004913	200.5129	0.0000
D(VI00ES)	0.019488	0.003300	5.904896	0.0000

R-squared	0.909649	Mean dependent var	2979.372
Adjusted R-squared	0.907641	S.D. dependent var	313.1138
S.E. of regression	95.15706	Akaike info criterion	11.99056
Sum squared resid	407469.0	Schwarz criterion	12.06929
Log likelihood	-279.7781	Hannan-Quinn criter.	12.02018
Durbin-Watson stat	1.716273		

Industry: Income approach

Dependent Variable: LIE
Method: Least Squares
Sample (adjusted): 1965 2012
Included observations: 48 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LIE(-1)	0.987270	0.005164	191.1874	0.0000
D(RI00E)	0.017491	0.003637	4.808985	0.0000

R-squared	0.893429	Mean dependent var	2981.301
Adjusted R-squared	0.891112	S.D. dependent var	310.0530
S.E. of regression	102.3119	Akaike info criterion	12.13470
Sum squared resid	481515.6	Schwarz criterion	12.21267
Log likelihood	-289.2329	Hannan-Quinn criter.	12.16417
Durbin-Watson stat	1.655073		

Building: production approach

Dependent Variable: LBE
Method: Least Squares
Sample (adjusted): 1966 2012
Included observations: 47 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LBE(-1)	0.990848	0.010321	96.00209	0.0000
D(VB00ES)	0.022039	0.003495	6.305694	0.0000

R-squared	0.958087	Mean dependent var	1352.922
Adjusted R-squared	0.957155	S.D. dependent var	486.0468
S.E. of regression	100.6065	Akaike info criterion	12.10193
Sum squared resid	455475.4	Schwarz criterion	12.18066
Log likelihood	-282.3954	Hannan-Quinn criter.	12.13156
Durbin-Watson stat	1.244132		

Building: income approach

Dependent Variable: LBE
Method: Least Squares
Sample (adjusted): 1966 2012
Included observations: 47 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LBE(-1)	0.983049	0.008855	111.0188	0.0000
D(RB00E)	0.021425	0.002500	8.571287	0.0000

R-squared	0.970012	Mean dependent var	1352.922
Adjusted R-squared	0.969345	S.D. dependent var	486.0468
S.E. of regression	85.09962	Akaike info criterion	11.76714
Sum squared resid	325887.5	Schwarz criterion	11.84587
Log likelihood	-274.5279	Hannan-Quinn criter.	11.79677
Durbin-Watson stat	2.127737		

Services: production approach

Dependent Variable: LSE
Method: Least Squares
Sample: 1966 2012

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LSE(-1)	0.988484	0.006488	152.3549	0.0000
D(VS00ES)	0.035243	0.005119	6.884728	0.0000

R-squared	0.996263	Mean dependent var	7474.041
Adjusted R-squared	0.996180	S.D. dependent var	3179.932
S.E. of regression	196.5521	Akaike info criterion	13.44135
Sum squared resid	1738472.	Schwarz criterion	13.52008
Log likelihood	-313.8718	Hannan-Quinn criter.	13.47098
Durbin-Watson stat	1.934152		

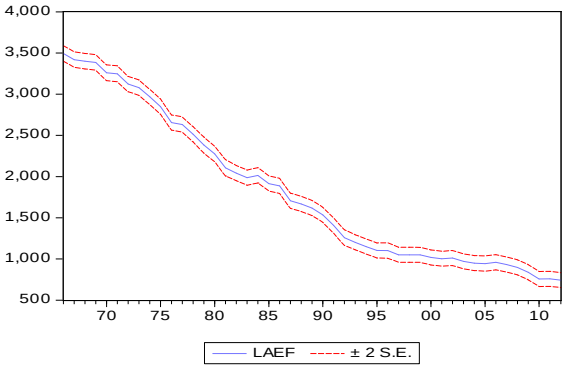
Services: Income approach

Dependent Variable: LSE
Method: Least Squares
Sample: 1966 2012
Included observations: 47

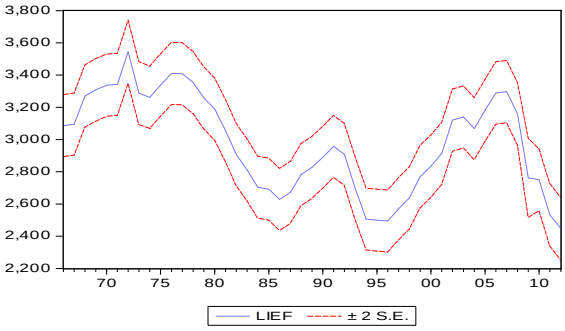
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LSE(-1)	1.012283	0.005360	188.8653	0.0000
D(RS00E)	0.013597	0.003173	4.285474	0.0001

R-squared	0.994550	Mean dependent var	7474.041
Adjusted R-squared	0.994429	S.D. dependent var	3179.932
S.E. of regression	237.3486	Akaike info criterion	13.81856
Sum squared resid	2535046.	Schwarz criterion	13.89729
Log likelihood	-322.7361	Hannan-Quinn criter.	13.84818
Durbin-Watson stat	1.641692		

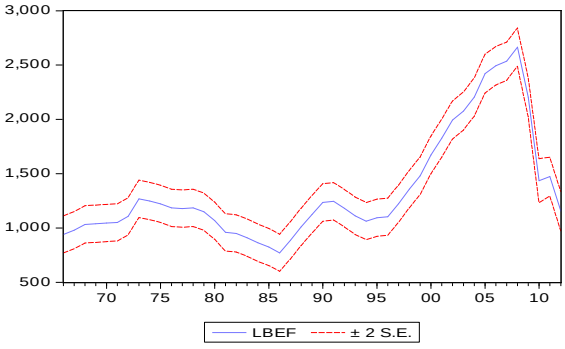
The following graphs show actual and fitted values of employment by sector.



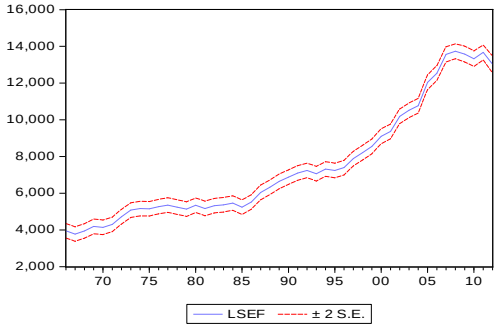
Forecast: LAEF	
Actual: LAE	
Forecast sample: 1966 2012	
Included observations: 47	
Root Mean Squared Error	44.37272
Mean Absolute Error	33.78831
Mean Abs. Percent Error	2.100581
Theil Inequality Coefficient	0.010954
Bias Proportion	0.000531
Variance Proportion	0.005063
Covariance Proportion	0.994405



Forecast: LIEF	
Actual: LIE	
Forecast sample: 1966 2012	
Included observations: 47	
Root Mean Squared Error	93.11043
Mean Absolute Error	66.63527
Mean Abs. Percent Error	2.214902
Theil Inequality Coefficient	0.015546
Bias Proportion	0.000031
Variance Proportion	0.009600
Covariance Proportion	0.990369



Forecast: LBEF	
Actual: LBE	
Forecast sample: 1966 2012	
Included observations: 47	
Root Mean Squared Error	83.26930
Mean Absolute Error	52.11106
Mean Abs. Percent Error	3.579885
Theil Inequality Coefficient	0.029021
Bias Proportion	0.007395
Variance Proportion	0.023322
Covariance Proportion	0.969283



Forecast: LSEF	
Actual: LSE	
Forecast sample: 1966 2012	
Included observations: 47	
Root Mean Squared Error	192.3246
Mean Absolute Error	130.2784
Mean Abs. Percent Error	1.897892
Theil Inequality Coefficient	0.011860
Bias Proportion	0.009578
Variance Proportion	0.070507
Covariance Proportion	0.919915

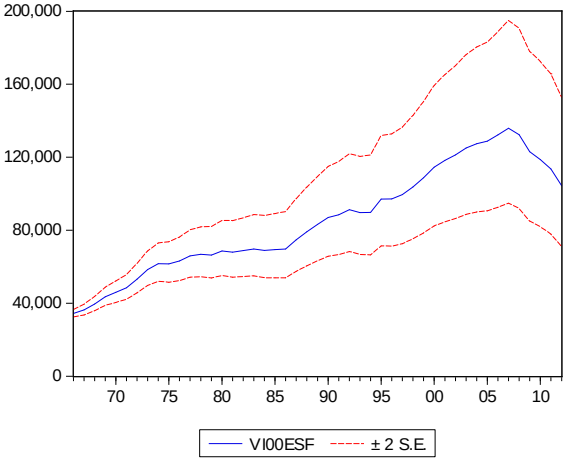
Annex 2. Demand equations of Industry in Spain, 1966-2012

Equation 3.1. Demand of Real Value-added of Industry related with IPRI00ES, VNI00ES and Ti.
Dependent Variable: LOG(VI00ES)
Method: Least Squares
Sample: 1966 2012
Included observations: 47

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(VI00ES(-1))	0.998935	0.000986	1013.366	0.0000
D(LOG(VNI00ES))	1.292766	0.191897	6.736770	0.0000
D(LOG(IPRI00E))	-0.697762	0.174646	-3.995293	0.0002
TI	-0.000446	0.000351	-1.270449	0.2108

R-squared	0.994467	Mean dependent var	11.32430
Adjusted R-squared	0.994081	S.D. dependent var	0.356201
S.E. of regression	0.027405	Akaike info criterion	-4.274897
Sum squared resid	0.032295	Schwarz criterion	-4.117437
Log likelihood	104.4601	Hannan-Quinn criter.	-4.215644
Durbin-Watson stat	2.019632		

Note: the S.E., SCE and Mean of dep. Variable correspond to log(Y) and not to Y. Results for Y: S.E. of regresión for Y=VI00ES = 4850. Sum of Squares of residuals for Y = 1.04 E+09. %S.E. on mean of Y = 10.62. Mean of Absolute Percentage Error (MAPE) of dynamic forecasts for Y = 4.62%.



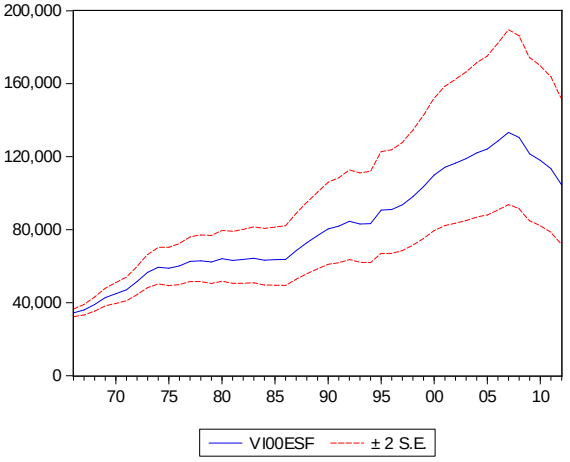
Forecast: VI00ESF	
Actual: VI00ES	
Forecast sample: 1966 2012	
Included observations: 47	
Root Mean Squared Error	4692.805
Mean Absolute Error	3896.766
Mean Abs. Percent Error	4.626196
Theil Inequality Coefficient	0.025800
Bias Proportion	0.229986
Variance Proportion	0.085187
Covariance Proportion	0.684827

Equation 3.2. Demand of Real Value-added of Industry related with IPRI00ES and VNI00ES
Dependent Variable: LOG(VI00ES)
Method: Least Squares
Date: 06/09/13 Time: 22:18
Sample (adjusted): 1966 2012
Included observations: 47 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(VI00ES(-1))	0.997912	0.000572	1743.839	0.0000
D(LOG(VNI00ES))	1.392646	0.176270	7.900628	0.0000
D(LOG(IPRI00E))	-0.752955	0.170333	-4.420501	0.0001

R-squared	0.994259	Mean dependent var	11.32430
Adjusted R-squared	0.993998	S.D. dependent var	0.356201
S.E. of regression	0.027596	Akaike info criterion	-4.280602
Sum squared resid	0.033507	Schwarz criterion	-4.162507
Log likelihood	103.5941	Hannan-Quinn criter.	-4.236162
Durbin-Watson stat	1.944225		

Sum squared residuals of Y=VI00es: 32.5 E+08. S.E. of regression of Y = 8594.
MAPE of dynamic forecasts for Y: 8.56.



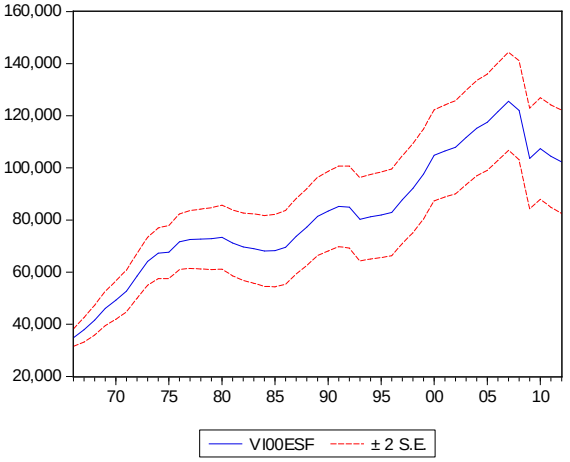
Forecast: VI00ESF	
Actual: VI00ES	
Forecast sample: 1965 2012	
Adjusted sample: 1966 2012	
Included observations: 47	
Root Mean Squared Error	8317.523
Mean Absolute Error	7255.475
Mean Abs. Percent Error	8.558899
Theil Inequality Coefficient	0.046725
Bias Proportion	0.553609
Variance Proportion	0.011375
Covariance Proportion	0.435017

Equation 4. Demando of Real Value-Added of Industry related with C00Es and EXPT00ES
Dependent Variable: VI00ES
Method: Least Squares
Sample: 1966 2012
Included observations: 47

Variable	Coefficient	Std. Error	t-Statistic	Prob.
VI00ES(-1)	0.992179	0.007577	130.9393	0.0000
D(C00ES)	0.408302	0.034653	11.78264	0.0000
D(EXPT00ES)	0.190741	0.034797	5.481468	0.0000
TI	-98.33052	29.71825	-3.308759	0.0019

R-squared	0.996727	Mean dependent var	87632.39
Adjusted R-squared	0.996499	S.D. dependent var	27659.63
S.E. of regression	1636.607	Akaike info criterion	17.71990
Sum squared resid	1.15E+08	Schwarz criterion	17.87736
Log likelihood	-412.4177	Hannan-Quinn criter.	17.77916
Durbin-Watson stat	1.662945		

Note: C00Es is real private consumption of Spain in Euros at 2000 prices. EXPT00ES is Exports Total.



Forecast: VI00ESF
Actual: VI00ES
Forecast sample: 1966 2012
Included observations: 47

Root Mean Squared Error	8751.548
Mean Absolute Error	6926.344
Mean Abs. Percent Error	7.231912
Theil Inequality Coefficient	0.049553
Bias Proportion	0.460782
Variance Proportion	0.276259
Covariance Proportion	0.262959

Annex 3. Spanish Annex

Modelo intersectorial de 6 países de la OCDE (sección 2.4 del libro EE9. Ecuación de QHNI

$$QHNI_t = F(QHNI_{t-1}, D(QHI_t), D(IMPBH_t), D(EXPBH_t)$$

QHNI y QHI son, respectivamente, el VAB per cápita de los sectores no industriales e industriales, mientras IMPBH y EXPBH muestran el nivel de comercio exterior por habitante en Importaciones y Exportaciones de bienes. Los datos están expresados en miles de Dólares por habitante a precios y TC del 2000.

Estimación de la ecuación de QHNI en 6 países de la OCDE, 1993-2010
Dependent Variable: QHNI00? Method: Pooled Least Squares
Sample (adjusted): 1993 2010. Included observations: 18
Cross-sections included: 6. Total pool (unbalanced) observations: 86
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
QHNI00?(-1)	1.015261	0.001539	659.6649	0.0000
D(QHI00?)	0.388669	0.210720	1.844478	0.0687
D(IMPBH00?)	0.670343	0.160444	4.178048	0.0001
D(EXPBH00?)	-0.405141	0.155843	-2.599669	0.0111

R-squared	0.998371	Mean dependent var	17.64640
Adjusted R-squared	0.998312	S.D. dependent var	5.198703
S.E. of regression	0.213596	Akaike info criterion	-0.204067
Sum squared resid	3.741100	Schwarz criterion	-0.089911
Log likelihood	12.77489	Hannan-Quinn criter.	-0.158125
Durbin-Watson stat	1.252632		

La bondad del ajuste es elevada, los parámetros son significativos al 10% de significación y algunos a niveles menores. Los signos de los coeficientes son los esperados. La suma de los coeficientes de Importaciones y Exportaciones es positiva, indicando que, en general, un incremento simultáneo en ambas variables tiene un impacto positivo, siempre que ese incremento no implique un endeudamiento exterior excesivo (empeoramiento de la posición internacional neta (PIN), u otros efectos que puedan tener consecuencias negativos sobre la producción industrial. En el caso de la economía española en el período 2000-2007 se produjo un fuerte endeudamiento exterior que ha tenido consecuencias negativas para la evolución de la producción industrial por habitante y de la tasa de empleo.

Ecuación de empleo en los Servicios en función de VS00ES y PAE

Dependent Variable: LSE. Least Squares. 1966-2010. Observations: 45				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LSE(-1)	0.989164	0.007410	133.4861	0.0000
D(VS00ES/1000)	27.82100	5.485712	5.071538	0.0000
D(PAE)	0.271996	0.137100	1.983914	0.0538
R-squared	0.996461	Mean dependent var		7219.394
Adjusted R-squared	0.996292	S.D. dependent var		3001.903
S.E. of regression	182.7921	Akaike info criterion		13.31892
Sum squared resid	1403344.	Schwarz criterion		13.43936
Log likelihood	-296.6756	Hannan-Quinn criter.		13.36382
Durbin-Watson stat	2.280560			

Nota: PAE es la Población Activa de España

Spanish Data.

Tabla 2.VAB real (mill.€ 2000), Renta real (mill.€2000), VAB a precios corrientes (mill.€) e índices de precios del VAB sectorial: Agriculture (A), Industry (I), Building (B) and Services (S).

Año	VA 00es	VI 00es	VB 00es	VS 00es	VT 00es	IPA 00es	IPI 00es	IPB 00es	IPS 00e
1965	13460	30789	17801	108208	170259	0.1468	0.0922	0.0333	0.0399
1970	14867	46686	24997	145083	231633	0.1692	0.1080	0.0539	0.0444
1975	18146	65848	29155	186949	300098	0.2828	0.1758	0.1097	0.0877
1980	20116	73169	24699	212116	330100	0.4801	0.3717	0.2789	0.2157
1985	21334	74622	24306	231724	351985	0.6927	0.6506	0.4034	0.3917
1990	21509	91385	38436	287266	438597	0.9652	0.8500	0.6469	0.5655
1995	17667	96159	38230	319204	471260	1.0510	0.9391	0.8076	0.8540
2000	24984	119217	47584	378775	570560	1.0000	1.0000	1.0000	1.0000
2005	22410	126575	63933	449561	662479	1.1607	1.1677	1.4673	1.2149
2010	22109	110535	59541	496395	688580	1.1513	1.4040	1.9277	1.3420

Fuente: Elaboración por Guisán(2013) a partir de datos del INE. El dato de IPC00E se ha obtenido dividiendo el Consumo a precios corrientes por el consumo a precios constantes del año 2000.

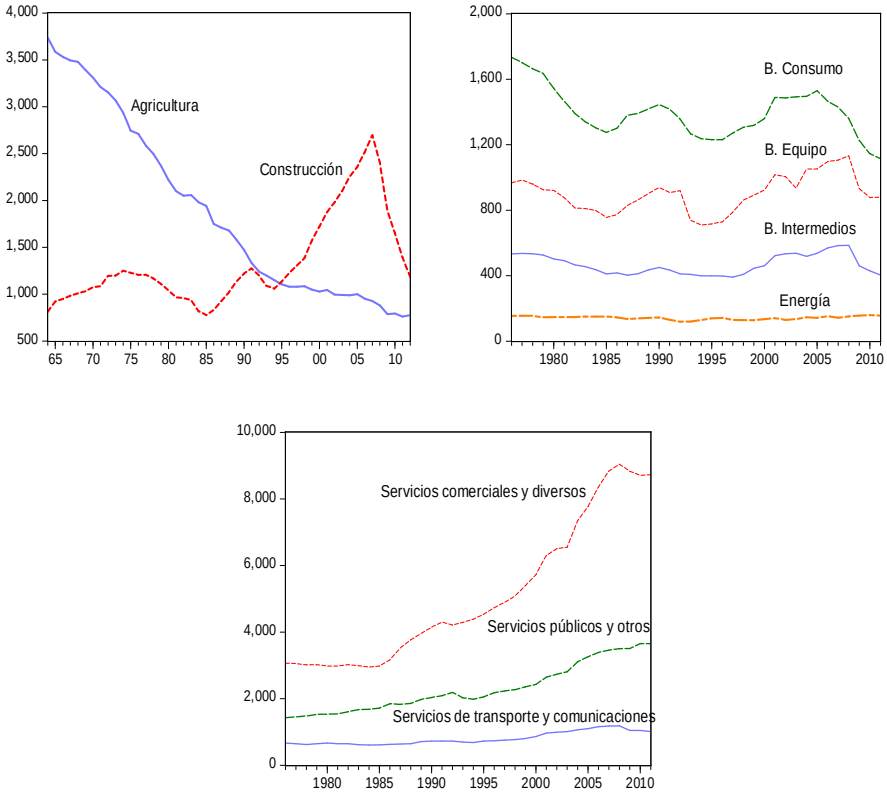
Table 3. Real IncomeRenta real (mill.€2000), VAB a precios corrientes (mill.€) e índice de precios al Consumo (IPC)

Año	RA 00es	RI 00es	RB 00e	RS 00e	VA ES	VI ES	VB ES	VS ES	IPC 00e
1965	38259	51730	10164	76221	1808	2445	480	3602	0.0473
1970	40809	72668	18713	104780	2581	4595	1183	6626	0.0632
1975	43109	98311	27116	124158	4440	10126	2793	12788	0.1030
1980	37783	100158	25773	163642	8992	23838	6134	38947	0.2380
1985	31440	98993	19568	182636	14054	44250	8747	81638	0.4470
1990	31213	116812	32791	229400	19477	72891	20462	143146	0.6240
1995	22917	110434	33612	274652	19090	91991	27999	228786	0.8330
2000	24974	116255	42793	361289	24075	112070	41252	348283	0.9640
2005	24089	123138	70845	448010	27365	139885	80480	508939	1.1360
2010	19897	116082	79422	538977	25732	150125	102713	697039	1.2933
2011	19110	116510	86168	500128	25454	155191	114776	666171	1.3320
2012	18874	121119	82227	495247	25944	166490	113029	680767	1.3746

VjES es el VAB a precios corrientes del sector j de España (millones de Euros) j=A, I, B, S
Vj00ES = Es la producción real, o VAB real según enfoque producción. Millones de € del 2000.
Rj00ES= Es el VAB real según enfoque renta. Mide el poder adquisitivo del VAB sectorial.

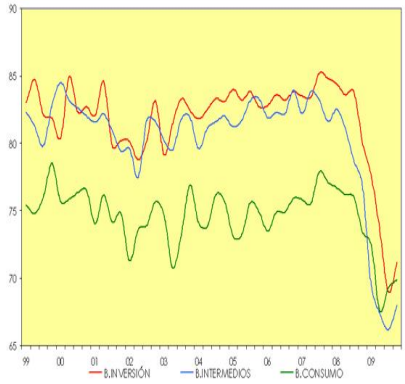
Se pueden calcular la Renta real no agraria (RNA00E) y la Producción real no agrario (VNA00ES):
RNA00E=RI00ES+RB00ES+RS00ES;
VNA00ES=VI00ES+VB00ES+VS00ES

Spanish annex: Employment by sector



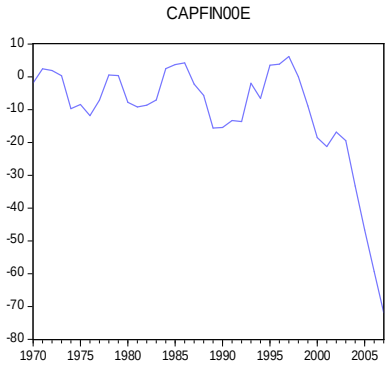
Fuente: Elaboración por Guisán(2013) a partir de datos de la EPA del INE. Datos en miles de personas ocupadas.

Gráfico 5. Capacidad utilizada en la industria (%).



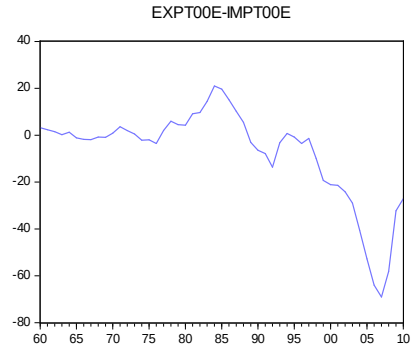
Fuente: Ministero de Industria.

Gráfico 6. Capacidad de Financiación



Fuente: Ministero de Industria.

Gráfico 7. Saldo de Balanza Comercial



Fuente: Elaboración a partir de datos del INE. Miles de millones a precios del 2000